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# Test and Evaluation Report of the Human Technology Ambulatory Cortemp Recorder Model COR-124

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Human Technology Ambulatory Cortemp Recorder Model COR-124 was tested for electromagnetic interference/compatibility in the UH-60A helicopter under the U.S. Army Program for Testing and Evaluation of Equipment for Aeromedical Operations. The tests were conducted using current military and industrial standards and procedures for electromagnetic interference/compatibility and human factors. The Human Technology Ambulatory Cortemp Recorder Model COR-124 was found to be compatible with the U.S. Army medical evacuation UH-60A Blackhawk.

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## Section 1. Executive digest.

The Army program for Test and Evaluation of Aeromedical Equipment uses existing military standards (MIL-STD) and collective professional expertise to test and evaluate selected medical equipment proposed for use aboard Army aircraft. Equipment meeting these standards ensures the safety of the crew, patients, and aircraft by eliminating risks due to: (1) Interference by the medical equipment with aircraft systems/subsystems operation, (2) the aircraft system's interference with the operation of the medical equipment, (3) the medical equipment's susceptibility to environmental exposure, or (4) physical and/or functional incompatibility while in use on board selected rotary-wing aircraft. This program tests both developmental and nondevelopmental (off the shelf) medical equipment destined for use aboard Army medical evacuation (MEDEVAC) aircraft.

### 1.1 TEST OBJECTIVES

1.1.1 To determine if the medical equipment is complete and operational per the manufacturer's operating instructions.

1.1.2 To ensure the electrical safety of the medical equipment.

1.1.3 To ensure the equipment will function as designed throughout the rated battery operation time.

1.1.4 To ensure the safety of the operator, the patient, and the aircrew.

1.1.5 To assess design considerations which could potentially contribute to an operator error.

1.1.6 To determine if the medical equipment can function as designed in a low pressure environment.

1.1.7 To determine the ability of the medical equipment to withstand the vibrational stresses expected in a rotary-wing flight environment without degradation or malfunction.

1.1.8 To determine the ability of the medical equipment to be stored and operated in a high temperature environment.

1.1.9 To determine the ability of the medical equipment to be stored and operated in a low temperature environment.

1.1.10 To determine the ability of the medical equipment to operate satisfactorily for short periods during exposure to high humidity conditions.

1.1.11 To assess the levels of electromagnetic emissions produced by the medical equipment within selected frequency ranges.

1.1.12 To assess the minimum electromagnetic susceptibility levels of the medical equipment within selected frequency ranges.

1.1.13 To assess the physical and/or functional compatibility of the medical equipment while in use on board the aircraft.

1.1.14 To assess the electromagnetic interference (EMI) and electromagnetic compatibility (EMC) characteristics of the medical equipment with the host aircraft and its installed systems.

1.2 TESTING AUTHORITY

Research and Technology Work Unit Summary, dated 5 October 1989. Project number 3M463807D836, titled, Army Program for Testing and Evaluation of Equipment for Aeromedical Operations.

1.3 SCOPE

1.3.1 This test was conducted at the United States Army Aeromedical Research Laboratory (USAARL), Cairns Army Airfield (CAAF), and designated test flight areas in and around Fort Rucker, Alabama.

1.3.2 The USAARL UH-60A aircraft, serial number 88-26069, with subsystems delineated in paragraph 3.2.2, was configured with the Human Technology Ambulatory Cortemp Recorder*, model COR-124, and used as the test aircraft for the in-flight evaluation. The in-flight evaluation required 3.4 flight hours.

1.3.3 Laboratory testing was accomplished at USAARL using government furnisned equipment (GFE) by Universal Energy Systems, Inc. (UES), under contract No. DAMD 17-86-C-6215.

1.3.4 Prior to flight testing, the following tests were accomplished: Acceptance inspection, equipment training, electromagnetic compatibility, human factors and safety, environmental compatibility, and in-flight compatibility.

1.3.5 An airworthiness release (AWR) dated 27 Dec 1991 was received from the U.S. Army Aviation Systems Command (AVSCOM) prior to the in-flight testing of the Ambulatory Cortemp Recorder.

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* See list of manufacturers

## 1.4 MATERIAL DESCRIPTION

The Human Technology Ambulatory Cortemp Recorder is a portable core temperature measurement and recording device. It is used in conjunction with a disposable temperature sensor (DTS). The DTS is an ingestible pill approximately 3/4 inch in length and 3/8 inch in diameter. The DTS transmits a magnetic field with a frequency corresponding to its temperature. A bandoleer-type antenna is worn on the torso of the patient which receives the transmitted signal from the DTS. The useable temperature range of the Cortemp Recorder is 50 to 122°F (10 to 50°C). The Cortemp Recorder will display "NO READ 05" or "WEAK SIGNAL" if the temperature exceeds the temperature range or a weak signal is detected. The Cortemp Recorder is powered by a 9-volt alkaline battery. A 25-pin RS-232 printer port is located on the front of the unit.

## 1.5 SUMMARY

### 1.5.1 Laboratory testing

1.5.1.1 Battery Life Evaluation: The Ambulatory Cortemp Recorder was operated with a new 9-volt alkaline battery sampling the temperature sensor every 30 seconds. In this mode, the unit operated an average of 14 hours and 50 minutes among three trials. This agrees with the manufacturer's specification of 12 to 26 hours operation with a new battery.

1.5.1.2 Human Factors Evaluation: The Ambulatory Cortemp Recorder was found to be unsatisfactory in five categories of the evaluation criteria. These included visual displays, controls, maintainability, labels and coding, and safety. The front panel labels do not accurately indicate the functions of some of the switches. The marker button on the top of the unit is not labeled. There is little or no tactile feedback from the front panel switches. The power switch is part of the battery compartment cover. The cover may be misplaced making the unit inoperative and, while the unit is in place, it is not possible to turn the unit on or off. The manual has several errors and there are no manufacturer specifications listed in the manual.

1.5.1.3 Environmental Tests: The Ambulatory Cortemp Recorder can be expected to perform in a variety of environmental conditions. Its performance was found to be satisfactory in all stages of the environmental testing. The requirements for environmental tests are established in MIL-STD-810D, Methods 500.2 (altitude), 514.3 (vibration), 501.2 (high temperature), 502.2 (low temperature), and 507.2 (humidity).

1.5.1.4 Radiated Emissions Tests (RE02): The Ambulatory Cortemp Recorder may be unsatisfactory for use in certain EMI sensitive

environments. Narrowband (NB) and broadband (BB) radiated emissions were detected in the test frequency ranges. Some narrowband and broadband emissions exceeded the test limits. Emission limits are set forth in MIL-STD-461A, Notice 4.

1.5.1.5 Radiated Susceptibility Test (RS03): The Human Technology Cortemp Recorder may be unsuitable for use in the presence of EMI. The Ambulatory Cortemp Recorder was found to be susceptible to radio frequency interference (RFI) in the testing range and magnitude.

1.5.2 In-flight testing

1.5.2.1 During the in-flight human factors evaluation, the Ambulatory Cortemp Recorder was found to be unsatisfactory in the categories of the evaluation as noted in 1.5.1.2. The membrane switches were difficult to operate while wearing the flight gloves due to a lack of tactile feedback from the membrane switches. The battery compartment cover can become dislodged and lost when placed in the "OFF" position. The liquid crystal display (LCD) could easily be read in the aircraft.

1.5.2.2 The aircraft and its subsystems were not adversely affected by the operation of the Ambulatory Cortemp Recorder in any of the prescribed flight test modes.

1.5.2.3 The Ambulatory Cortemp Recorder was not affected by the aircraft and its subsystems during the in-flight testing.

1.6 CONCLUSIONS

Based on the results of laboratory and in-flight testing, the Ambulatory Cortemp Recorder was found to be compatible with the U.S. Army medical evacuation UH-60A Blackhawk with the subsystems listed in paragraph 3.2.2. Deficiencies in the design and manuals require that the operator be familiar with the operation of the device prior to use in the aircraft.

## Section 2. Subtests.

### 2.1 INITIAL INSPECTION

#### 2.1.1 Objective

To determine if the Ambulatory Cortemp Recorder is complete and operational for testing per the manufacturer's operating instructions.

#### 2.1.2 Criteria

2.1.2.1 The physical inventory is conducted solely for investigation and documentation.

2.1.2.2 The Ambulatory Cortemp Recorder will display consistent and accurate measurements as an acceptable performance test.

#### 2.1.3 Test procedure

2.1.3.1 A complete physical inventory of the Ambulatory Cortemp Recorder was completed per the manufacturer's equipment list.

2.1.3.2 An operational validation test of the Ambulatory Cortemp Recorder was conducted per the manufacturer's operating instructions by USAARL's personnel.

#### 2.1.4 Test findings

2.1.4.1 The Ambulatory Cortemp Recorder was inventoried and found to be complete.

2.1.4.2 The Ambulatory Cortemp Recorder operated as prescribed in the manufacturer's operating manual. Criteria met.

### 2.2 BATTERY LIFE EVALUATION (Laboratory)

#### 2.2.1 Objective

To ensure the equipment will function as designed throughout the rated battery operation time.

#### 2.2.2 Criterion

Verify manufacturer's specified full power internal battery life expectancy of 12 to 26 hours during continuous operation in the 30-second mode, with the recorder on, and temperature measurements taken automatically at 30-second intervals.

2.2.3 Test procedure

2.2.3.1 Charging and operation cycles were conducted in ambient room conditions.

2.2.3.2 The Ambulatory Cortemp Recorder was operated continuously using a new 9-volt alkaline battery in the 30-second temperature cycle mode until a low battery indication occurred. The depletion time was noted and the battery was replaced. This procedure was repeated three times.

2.2.4 Test findings

The test was conducted using new internal batteries. The average operating time in testing was 14.83 hours at room temperature. This meets manufacturer's specification of 12 to 26 hours of operation. Criterion met.

2.3 HUMAN FACTORS EVALUATION 'Laboratory)

2.3.1 Objectives

2.3.1.1 To assure the safety of the operator, the potential patient, and the aircrew.

2.3.1.2 To assess the design considerations which could potentially contribute to an operator error.

2.3.2 Criterion

The Ambulatory Cortemp Recorder must be rated satisfactory in all major categories of the evaluation. These include: (1) Visual displays, (2) controls, (3) maintainability, (4) conductors, (5) fasteners, (6) test points, (7) test equipment, (8) fuses and circuit breakers, (9) labels and coding, and (10) safety.

2.3.3 Test procedure

2.3.3.1 The evaluation was conducted in a laboratory under fluorescent lighting and ambient room conditions.

2.3.3.2 The Ambulatory Cortemp Recorder was operated according to prescribed instructions through its full range of functions.

2.3.4 Test finding

The Ambulatory Cortemp Recorder was found to be unsatisfactory in five of the evaluation criteria. These included visual displays, controls, maintainability, labels and coding, and safety. Criterion partially met.

## 2.4 ALTITUDE (LOW PRESSURE) TEST [IAW MIL-STD-810D, METHOD 500.2]

### 2.4.1 Objective

To determine if the Ambulatory Cortemp Recorder can function as designed in a low pressure environment.

### 2.4.2 Criterion

The Ambulatory Cortemp Recorder will display consistent and accurate measurements while exposed to an altitude equivalency of 15,000 feet above sea level.

### 2.4.3 Test procedure

2.4.3.1 A pretest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.4.3.2 The altitude test was performed in a Tenney Engineering model 64S altitude chamber*. This test was based on MIL-STD-810D, Method 500.2. The Ambulatory Cortemp Recorder was turned on in the standby mode and placed on the floor of the chamber. Chamber pressure was decreased to 420 mmHg (15,000 ft equivalent altitude) over a 15-minute period, held constant for 60 minutes, then raised, at 1500 fpm, to ambient conditions (760 mmHg) over a 10-minute period. There were no provisions for the control of temperature or humidity inside this chamber.

2.4.3.3 A posttest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder after the exposure to low pressure.

### 2.4.4 Test findings

2.4.4.1 The pretest performance check met criterion 2.1.2.2.

2.4.4.2 No failures in the performance of the Ambulatory Cortemp Recorder were noted before, during, or after the altitude test. Criterion met.

2.4.4.3 The posttest performance check met criterion 2.1.2.2.

## 2.5 VIBRATION TEST [IAW MIL-STD-810D, METHOD 514.3]

### 2.5.1 Objective

To determine the ability of the Ambulatory Cortemp Recorder to withstand the vibrational stresses expected in a rotary-wing environment without degradation or malfunction.

2.5.2 Criterion

The Ambulatory Cortemp Recorder will remain operational and be able to display consistent and accurate measurements while exposed to vibrational stresses.

2.5.3 Test procedure

2.5.3.1 A pretest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.5.3.2 The vibration test was performed using an Unholtz-Dickey model TA115-40/CSTA vibration test system*. It is a single-axis system with an electromagnetic driver unit. The test consisted of sinusoidal vibrations superimposed on random vibrations over a frequency range of 500 Hz, as shown below. These vibrations are derived from measurements taken on the floor under the copilot's seat in a UH-1 helicopter traveling at 120 knots. The reference spectrum breakpoints are from MIL-STD-810D, Method 514.3; reference spectrum levels are based on field measurements with a conservatism factor ofp906X1.5ndependent tests were conducted in the X, Y, and Z axes.

Z-axis

duration: 60 minutes
broadband intensity: 0.4506 $G_{rms}$
random vibration: initial slope : 99.00 dB/oct
5 Hz level: 0.00006210 $G_{sqr/Hz}$
100 Hz level: 0.0006210 $G_{sqr/Hz}$
300 Hz level: 0.0006210 $G_{sqr/Hz}$
500 Hz level: 0.00006210 $G_{sqr/Hz}$
final slope: -99.00 dB/oct
sinusoidal vibration: .5450 $G_{pk}$ at 11.25 Hz
.1690 $G_{pk}$ at 22.50 Hz
.1200 $G_{pk}$ at 33.75 Hz
.0310 $G_{pk}$ at 45.00 Hz
.0530 $G_{pk}$ at 56.25 Hz

X and Y axes

duration: 60 minutes each
broadband intensity: 0.3099 $G_{rms}$
random vibration: initial slope: 99.00 dB/oct
5 Hz level: 0.00002920 $G_{sqr/Hz}$
100 Hz level: 0.0002920 $G_{sqr/Hz}$
300 Hz level: 0.0002920 $G_{sqr/Hz}$
500 Hz level: 0.00002920 $G_{sqr/Hz}$
final slope: -99.00 dB/oct

sinusoidal vibration: .3200 $G_{pk}$ at 11.25 Hz
.0670 $G_{pk}$ at 22.50 Hz
.0950 $G_{pk}$ at 33.75 Hz
.0350 $G_{pk}$ at 45.00 Hz
.0770 $G_{pk}$ at 56.25 Hz

The Ambulatory Cortemp Recorder was strapped to the vibration table fixture, and its performance was evaluated before, during, and after exposure to vibration.

2.5.3.3 A posttest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.5.4 Test findings

2.5.4.1 The pretest performance check met criterion 2.1.2.2.

2.5.4.2 No failures in the performance of the Ambulatory Cortemp Recorder occurred before, during, or after exposure to vibration. Criterion met.

2.5.4.3 The posttest performance check met criterion 2.1.2.2.

2.6 HIGH TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 501.2]

2.6.1 Objective

To determine the ability of the Ambulatory Cortemp Recorder to be stored and operated in a high temperature environment.

2.6.2 Criteria

2.6.2.1 The Ambulatory Cortemp Recorder will display consistent and accurate measurements during the high temperature operation check.

2.6.2.2 The Ambulatory Cortemp Recorder will display consistent and accurate measurements after the high temperature storage cycle.

2.6.3 Test procedure

2.6.3.1 A pretest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.6.3.2 The high temperature test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test was based on MIL-STD-810D, Method 501.2. For the high temperature operation test, the Ambulatory Cortemp

Recorder was turned on and placed on the floor of the environmental chamber. The chamber temperature was raised to 49°C and the humidity was stabilized at a maximum of 20 percent relative humidity (RH) within 15 minutes. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. Temperature and humidity were held constant for 2 hours. At 30-minute intervals, the chamber door was opened briefly to minimize the change in chamber conditions during performance checks. After the operational test, the Ambulatory Cortemp Recorder was allowed to return to ambient conditions over a 30-minute period.

2.6.3.3 A posttest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.6.3.4 The Ambulatory Cortemp Recorder was stored (not operated) at temperatures of 63°C for 1 hour, 71°C for 4 hours, then again at 63°C for 1 hour. The chamber and Ambulatory Cortemp Recorder then were returned to ambient conditions over a 30-minute period.

2.6.3.5 A poststorage performance check was conducted to ensure proper performance of the Ambulatory Cortemp Recorder.

2.6.4 Test findings

2.6.4.1 The pretest performance check met criterion 2.1.2.2.

2.6.4.2 No operational failures occurred during the high temperature test. Criterion met.

2.6.4.3 The posttest performance check met criterion 2.1.2.2.

2.6.4.4 The Ambulatory Cortemp Recorder functioned properly after the high temperature storage test. Criterion met.

2.7 LOW TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 502.2]

2.7.1 Objective

To determine the ability of the Ambulatory Cortemp Recorder to be stored and operated in a low temperature environment.

2.7.2 Criteria

2.7.2.1 The Ambulatory Cortemp Recorder will display consistent and accurate measurements during the low temperature operation check.

2.7.2.2 The Ambulatory Cortemp Recorder will display consistent and accurate measurements after the low temperature storage cycle.

2.7.3 Test procedure

2.7.3.1 A pretest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.7.3.2 The Ambulatory Cortemp Recorder was placed on the floor of the environmental chamber and the temperature was lowered to 0°C within 25 minutes. The environmental control system was capable of regulating temperature within 2°C. Humidity cannot be controlled in the chamber at freezing temperatures. The temperature was held constant for 2 hours. The chamber door was opened briefly every 30 minutes to minimize the change in chamber conditions, and a performance check was conducted. The chamber temperature then was raised to ambient temperature within a 30-minute period.

2.7.3.3 A posttest performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.7.3.4 The Ambulatory Cortemp Recorder was "stored" in a nonoperational mode. The Ambulatory Cortemp Recorder was placed on the floor of the environmental test chamber and the temperature was lowered to -46°C for 6 hours. The chamber then was raised to ambient temperature over a 30-minute period.

2.7.3.5 A poststorage performance check was conducted to ensure proper operation of the Ambulatory Cortemp Recorder.

2.7.4 Test findings

2.7.4.1 The pretest performance check met criterion 2.1.2.2.

2.7.4.2 No operational failures occurred during the low temperature test. Criterion met.

2.7.4.3 The posttest performance check met criterion 2.1.2.2.

2.7.4.4 The Ambulatory Cortemp Recorder functioned properly after the low temperature storage test. Criterion met.

2.8 HUMIDITY TEST [IAW MIL-STD-810D, METHOD 507.2]

2.8.1 Objective

To determine the ability of the Ambulatory Cortemp Recorder to operate satisfactorily for short periods of time during exposure to highly humid conditions.

2.8.2 Criterion

The Ambulatory Cortemp Recorder will display consistent and accurate measurements while exposed to a high humidity environment.

2.8.3 Test procedure

2.8.3.1 A pretest performance check was conducted to ensure the proper operation of the Ambulatory Cortemp Recorder.

2.8.3.2 The humidity test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test was based on MIL-STD-810D, Method 507.2. For the humidity test, the Ambulatory Cortemp Recorder was placed ready for operation on the floor of the environmental chamber. The chamber temperature was raised to a temperature of 30°C and a relative humidity of 95 percent within 25 minutes. Temperature and relative humidity were maintained for 4 hours. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. At 45-minute intervals, the performance of the blood pressure monitor was checked. The chamber door was opened briefly to minimize the change in chamber conditions. The chamber and the Ambulatory Cortemp Recorder were returned to ambient conditions before the posttest performance validation check was conducted.

2.8.3.3 A posttest performance check was conducted to ensure the proper operation of the Ambulatory Cortemp Recorder.

2.8.4 Test findings

2.8.4.1 The pretest performance check met criterion 2.1.2.2.

2.8.4.2 No failures were noted in the Ambulatory Cortemp Recorder performance checks conducted during the exposure to the high humidity environment. Criterion met.

2.8.4.3 The posttest performance check met criterion 2.1.2.2.

## 2.9 ELECTROMAGNETIC CHARACTERISTICS TEST [IAW MIL-STD-461A, Notice 4, and MIL-STD-462, Notice 3]

### 2.9.1 Objectives

2.9.1.1 To assess the maximum levels of radiated electromagnetic emissions produced by the Ambulatory Cortemp Recorder in the 14 kHz to 12.4 GHz frequency range.

2.9.1.2 To assess the tolerances of radiated electromagnetic susceptibility of the Ambulatory Cortemp Recorder within the 10 kHz to 10 GHz electric field.

### 2.9.2 Criteria

2.9.2.1 The Ambulatory Cortemp Recorder will not produce emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraph 6.13.

2.9.2.2 The Ambulatory Cortemp Recorder will not malfunction when it is subjected to radiated emissions as specified in MIL-STD-461A, Notice 4, paragraph 6.20.

### 2.9.3 Test procedure

2.9.3.1 The radiated emissions test was performed according to MIL-STD-462, Notice 3, Method RE02. The Ambulatory Cortemp Recorder was positioned on a wooden test stand inside the EMI chamber, 1 meter away from the receiving antennas. The antennas were mounted for both vertical and horizontal polarities and connected to EMI receivers.

2.9.3.2 The radiated susceptibility test was performed according to MIL-STD-462, Notice 3, Method RS03. The Ambulatory Cortemp Recorder was positioned on a wooden test stand inside the EMI chamber 1 meter away from the transmitting antennas. The antennas were mounted for both vertical and horizontal polarities and connected to radio frequency (RF) transmitters. A temperature sensor pill was submerged in warm water and placed on the test stand with the cortemp recorder. The Ambulatory Cortemp Recorder took temperature measurements at 30-second intervals. While the Ambulatory Cortemp Recorder was operating, it was monitored for faulty operation during exposures to fields of 1 V/m from 10 kHz to 2 MHz, and 5 V/m from 2 to 30 MHz, 10 V/m from 30 MHz to 2 GHz, and 5V/m from 2 to 10 GHz. The Ambulatory Cortemp Recorder was operated with battery power.

2.9.4 Test findings

2.9.4.1 During the radiated emissions test, emissions which exceeded specification limits of MIL-STD-461A, Notice 4, were detected as noted.

| Frequency range | Emission exceeding standard |
|---|---|
| 3.9590 - 24.159 MHz | 0.4 - 18.3 dB (NB) |
| 33.994 - 73.989 MHz | 8.0 - 36.7 dB (NB) |
| 100.80 - 171.83 MHz | 1.1 - 18.1 dB (NB) |
| 0.2 MHz | 1.9 dB (BB) |

Criterion partially met.

2.9.4.2 The Ambulatory Cortemp Recorder was found to be susceptible to RFI in the testing range as noted. With the software filter "on":

| Frequency range | Field strength |
|---|---|
| 40.2 MHz | 5.62 V/m |
| 128.6 - 149.0 MHz | 5.31 - 8.91 V/m |
| 264.0 MHz | 8.91 V/m |

With the software filter "off":

| Frequency range | Field strength |
|---|---|
| 30.0 MHz | 5.01 V/m |
| 40.2 MHz | 6.31 V/m |
| 70.8 MHz | 5.96 V/m |
| 145.6 - 159.2 MHz | 6.68 - 7.08 V/m |

Criterion partially met.

2.10 IN-FLIGHT HUMAN FACTORS EVALUATION

2.10.1 Objective

To assess the physical and/or functional compatibility of the Ambulatory Cortemp Recorder while in use onboard the aircraft.

2.10.2 Criterion

The flight surgeon will be able to operate the Ambulatory Cortemp Recorder without physical or functional restrictions aboard the aircraft. Major areas of concern include: Proper operation, visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.10.3 Test procedure

2.10.3.1 A human factors evaluation was performed IAW MIL-STD-1472D, AAMI Human Factors Engineering Guidelines, and UL-544 to ensure the compatibility of the Ambulatory Cortemp Recorder and the in-flight environment. The flight surgeon conducted the test wearing a flight suit, flight gloves, and an SPH-4B flight helmet. An evaluation of the compatibility with the nuclear, biological, and chemical (NBC) protective equipment was not conducted. Due to restrictions of the AWR, testing was conducted during daylight hours only.

2.10.3.2 Two Ambulatory Cortemp Recorders were tested during the flight evaluation. One recorded the temperature from a temperature sensor pill ingested by a volunteer subject and the other monitored a sensor pill in the ambient temperature. A 10-foot separation was maintained between the recorders and sensor pills during the in-flight testing.

2.10.4 Test findings

During the in-flight human factors evaluation, the Ambulatory Cortemp Recorder was found to be unsatisfactory in the areas previously identified in paragraph 2.3.4. Specific problems included difficulty with tactile feedback from the membrane switches while wearing the flight gloves and the high risk of losing the battery compartment cover while operating the unit in the aircraft. The LCD display was easily viewed with the ambient light in the aircraft and the recorders accurately reported the temperature of their respective temperature sensor pills. Criterion partially met.

2.11 IN-FLIGHT EMI/EMC CHARACTERISTICS TEST

2.11.1 Objective

To assess the EMI/EMC characteristics of the Ambulatory Cortemp Recorder with the host aircraft and its installed systems.

2.11.2 Criteria

2.11.2.1 The Ambulatory Cortemp Recorder will not radiate EMI to disrupt or interfere with other equipment or systems aboard the aircraft.

2.11.2.2 The aircraft will not radiate EMI to disrupt or interfere with the Ambulatory Cortemp Recorder's operation.

2.11.3 Test procedure

A qualitative EMI/EMC assessment was performed with both the Ambulatory Cortemp Recorder and the aircraft operating as source and victim. The Ambulatory Cortemp Recorder and applicable aircraft instruments and systems were monitored for unusual operation, readings, surges, or power anomalies for each check-list item (see pages 3-5 through 3-8).

2.11.4 Test findings

2.11.4.1 There were no adverse instances of EMI/EMC noted with the Ambulatory Cortemp Recorder acting as either the source or victim. Criterion met.

2.11.4.2 There were no adverse instances of EMI/EMC noted with the aircraft acting as either the source or victim. Criterion met.

## Section 3. Supporting documentation.

### 3.1 DETAILED TEST INFORMATION

#### 3.1.1 General information

3.1.1.1 Ambulatory Cortemp Recorder testing is not considered a major action significantly affecting the quality of the human environment and, therefore, qualifies for categorical exclusion A-28, appendix A, AR 200-1.

3.1.1.2 A safety pilot will be designated for each flight. Flight operations will be conducted in accordance with (IAW) the aircraft operator's manual, appropriate aircrew training manuals, and test item technical data.

#### 3.1.2 Material description

3.1.2.1 The Human Technology Ambulatory Cortemp Recorder is designed to measure and record a patient's core temperature. The Cortemp Recorder is used in conjunction with a DTS. The DTS is an ingestible pill. The power switch for the Cortemp Recorder is integral with the battery compartment cover on the back of the recorder. The recorder is turned "ON" when the battery cover on the back of the unit is snapped closed. The Cortemp Recorder conducts an internal self-test each time the unit is activated. A keypad on the front panel of the recorder contains 20-membrane switches which are labeled with numbers and function designators. The membrane switches allow the operator to enter data for test identification and to enter calibration and operation modes. During the operational setup, prompts and entered data are presented on a LCD located at the top of the front panel of the recorder.

Calibration of the unit for a specific DTS is accomplished by entering the serial number and calibration number of the DTS during the setup. The operator can set high or low temperature alarm limits, select Celsius or Fahrenheit temperature displays, and the sampling rate, and activate a filter which screens for spurious readings. The measurement filter operates when a current reading differs from the previous reading by more than 0.3°C. Filtering is accomplished by taking two additional readings and averaging them with the current reading. An audible three-beep tone is activated each time a measurement falls outside the temperature limits. The unit has an event button and an antenna port located on the top of the unit. A 25-pin RS-232 printer port is located on the front of the unit.

3.1.2.2 Method of Operation: DTS pills are kept in sealed plastic bags with an orange warranty label and a magnet attached

to the pill. Removing the magnet activates the DTS internal battery which is confirmed by "PILL ON" during the "PILL TEST" portion of the recorder setup. A weak battery is indicated by a "PILL OFF" indication with the magnet removed. After verifying the DTS pill operation, the orange label may be removed and the DTS swallowed by the patient. A bandoleer antenna is worn on the torso of the patient and receives the transmitted signal from the DTS. The antenna must be less than 25 cm from the DTS to receive the signal. The Cortemp Recorder calculates the patient's core temperature by measuring the frequency of the DTS magnetic field.

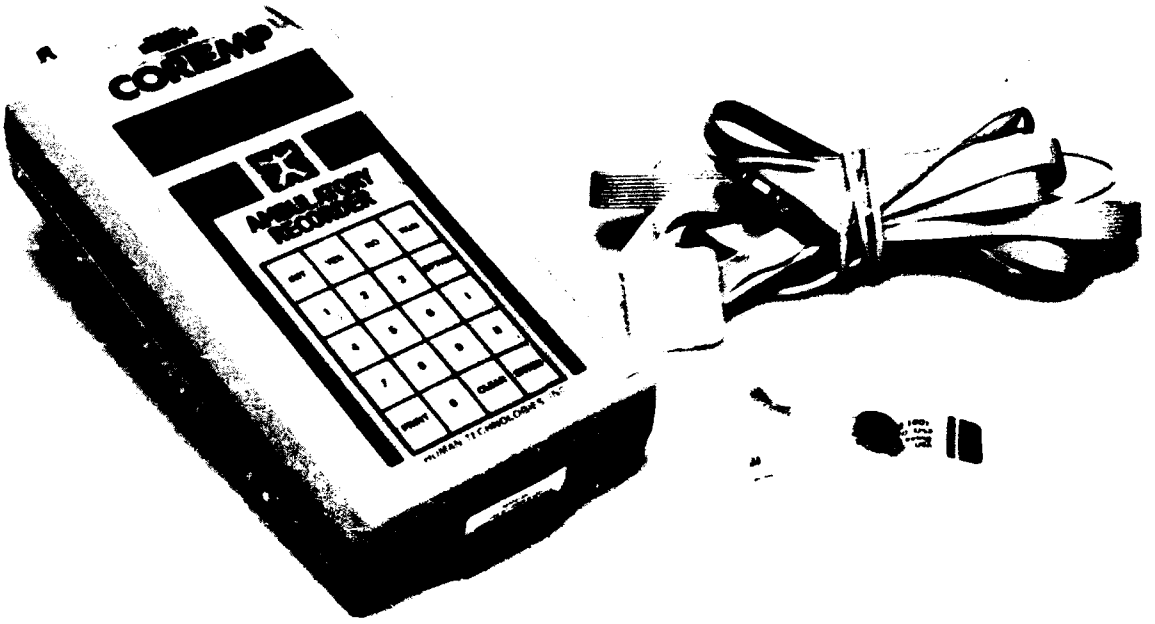
3.1.2.3 Dimensions: 7.5 x 4 x 2 in (19 x 10 x 5 cm).

3.1.2.4 Weight: 15 oz (425 gm).

3.1.2.5 Power requirements: The Cortemp Recorder is powered by one 9-volt alkaline battery.

## 3.2 TEST DATA

### 3.2.1 Photographic description



### 3.2.2 Aircraft equipment list

| Item No. | Nomenclature |
|---|---|
| 1 | Receiver radio -- R-1496A/ARN-89 (automatic direction finder) |
| 2 | Displacement gyro -- CN-1314/A |
| 3 | Gyro directional -- CN-998/ASN-43 |
| 4 | Signal data converter -- CV-3338/ASN-128 |
| 5 | Receiver -- R-2139/ARN-123 (VOR/LOC/MB/GS) |
| 6 | Command instrument system processor -- 70600-01038-101 |
| 7 | SAS amplifier -- 70901-02908-104 (flight control stability augmentation system) |
| 8 | Rate gyro -- TRU-2A/A |
| 9 | Amplifier, impedance -- AM-4859A/ARN-89 |
| 10 | Cargo hook -- FE-7590-145 |
| 11 | Receiver, radar -- RT-1193/ASN-128 (doppler navigation receiver) |
| 12 | Barometric altimeter -- AAU-31/A-1 |
| 13 | Barometric altimeter -- AAU-32A |
| 14 | Receiver/transmitter -- RT-1300/ARC-186 (VHF-AM and/or FM radio) |
| 15 | UHF-AM radio set -- RT-1518/ARC-164 |
| 16 | Interphone control -- C6533/ARC (aircraft intercom control) |
| 17 | Receiver/transmitter -- RT-1115D/APN-209 (radar altimeter) |
| 18 | Indicator altimeter -- ID-1917C/APN-209 (radar altimeter) |
| 19 | Control radio set -- C-7392A/ARN-89 (automatic direction finder) |
| 20 | Comparator signal data -- CM-482/ARC-186 (comparator for ARC-186) |
| 21 | Receiver/transmitter -- RT-1296A/APX-100 (transponder with IFF) |
| 22 | Computer display unit -- CP-1252/ASN-128 (doppler navigation system) |
| 23 | Compass set controller -- C-8021E/ASN75 |
| 24 | Magnetic compass - standby -- MS-17983-4 |

### 3.2.3 In-flight test data card

DATA CARD FORMAT

GUIDELINE FOR DATA COLLECTION

IN-FLIGHT SUITABILITY TEST OF MEDICAL ITEMS

| 1. Installation/removal. | Suitable Yes | Suitable No | Comments |
|---|---|---|---|
| a. Weight and balance (DD Form 365-4, Clearance Form F). | X | | |
| b. Space/area allocation. | | | |
| (1) Operational requirements. | X | | |
| (2) Storage requirements. | X | | |
| c. Interface connections (safe, positive, secure). | X | | |
| d. Installation/removal (expedient/easily achieved). | X | | |
| e. Mounting/final configuration (functional/stable). | X | | |

| 2. Operations and performance. | Suitable Yes | Suitable No | Comments |
|---|---|---|---|
| a. Manufacturer's operating instruction. | X | | |
| b. Medical item operation before aircraft run-up. | X | | |
| c. System interface during aircraft engine run-up and medical item operation (EMI switchology checklist). | X | | |
| (1) Aircraft voltage output. | X | | |

| | Suitable Yes | Suitable No | Comments |
|---|---|---|---|
| (2) Flight control function (UH-60). | X | | |
| (3) Stabilator function (UH-60). | X | | |
| (4) Radio communication vs. medical item operation. | | | |
| (a) FM | X | | |
| (b) UHF | X | | |
| (c) VHF | X | | |
| (5) Navigation equipment vs. medical item operation. | | | |
| (a) Transponder | X | | |
| (b) ADF | X | | |
| (c) VOR | X | | |
| (d) Doppler | X | | |
| (6) Radar altimeter operation vs. medical item operation. | X | | |
| d. System interface during aircraft hover and medical item operation (EMI switchology checklist). | | | |
| (1) Voltage output. | NA | | |
| (2) Radio communication vs. medical item operation. | | | |
| (a) FM | X | | |
| (b) UHF | X | | |
| (c) VHF | X | | |

| | Suitable Yes | No | Comments |
|---|---|---|---|
| (3) Navigation equipment operation vs. medical item operation. | | | |
| (a) Transponder | X | | |
| (b) ADF | X | | |
| (c) VOR | X | | |
| (d) Doppler | X | | |
| e. Flight mission profile vs. medical item operation (EMI switchology checklist). | | | |
| (1) Straight and level (1000 ft MSL for 20 minutes). | | | |
| (a) Compatibility of flight mode and medical item operation. | X | | |
| (b) Radio communication vs. medical item operation. | | | |
| a. FM | X | | |
| b. UHF | X | | |
| c. VHF | X | | |
| (2) NOE (20 minutes). compatibility of flight mode and medical item operation. | X | | |
| (3) FM homing (10 minutes). | X | | |
| (4) Doppler navigation vs. medical item operation. | | | |
| (a) Initialize function. | X | | |
| (b) Fix function. | X | | |
| (c) Update function. | X | | |

| | Suitable Yes | Suitable No | Comments |
|---|---|---|---|
| (5) VOR navigation vs. medical item operation. | X | | |
| (6) ILS approach vs. medical item operation. | X | | |
| f. Medical item operation after engine shutdown (external power source). | X | | |
| g. Restrictions to the medical item's use (i.e., electrical connectors). | X | | |
| h. Deviations from the laboratory test results. | | | |
| (1) Electrical/ electronic. | | None | |
| (2) Mechanical environment. | | None | |
| (3) Human factors (user interface, controls, markings, lighting, egress). | | None | |
| (4) Safety. | | None | |

3. Deviations from the in-flight test protocol: The VOR navigation portion of the in-flight test conducted at 2000 feet MSL due to air traffic control clearance.

### 3.2.4 EMI switchology checklist

EMI SWITCHOLOGY CHECKLIST UH-60 AIRCRAFT

IN-FLIGHT SUITABILITY OF MEDICAL ITEMS

| ENG INSTRUMENTS/CDU | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Fuel quantity | X | | | |
| Fuel indicator test | X | | | |
| XMSN oil temperature | X | | | |
| XMSN oil pressure | X | | | |
| #1 engine oil temperature | X | | | |
| #2 engine oil temperature | X | | | |
| #1 engine oil pressure | X | | | |
| #2 engine oil pressure | X | | | |
| #1 TGT | X | | | |
| #2 TGT | X | | | |
| #1 Ng speed | X | | | |
| #2 Ng speed | X | | | |
| CDU digits on/off | X | | | |
| CDU instruments dim | X | | | |

| ENG INSTRUMENTS/PLT PDU | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| #1 engine RPM | X | | | |
| #2 engine RPM | X | | | |
| Rotor RPM | X | | | |
| #1 torque | X | | | |
| #2 torque | X | | | |

| ENG INSTRUMENTS/COPLT PDU | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| #1 engine RPM | X | | | |
| #2 engine RPM | X | | | |
| Rotor RPM | X | | | |
| #1 torque | X | | | |
| #2 torque | X | | | |

| ENG CONTROLS | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| #1 overspeed | X | | | |
| #2 overspeed | X | | | |
| RPM switch | X | | | |
| #1 engine anti-ice | X | | | |
| #2 engine anti-ice | X | | | |
| #1 inlet anti-ice | X | | | |
| #2 inlet anti-ice | X | | | |

| RADIO EQUIPMENT | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| ICS, C-6533 ARC | X | | | |
| VHF-FM, ARC-186/115 | X | | | |
| VHF-AM, ARC-186/115 | X | | | |
| UHF-AM, ARC-164(V) | X | | | |
| Crypto, KY-28 | Not installed | | | |
| Radio retransmissions PLN | Not installed | | | |
| Transponder, APX-100(V) | X | | | |
| KIT-1A/TSEC IFF computer | Not keyed with code | | | |

| MISSION EQUIPMENT | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| RWR, APR-39(V) | Not installed | | | |
| IR CM, ALQ-144 | Not installed | | | |
| Chaff dispenser, M-130 | Not installed | | | |
| Cargo hook system | X | | | |

| HYDRAULIC CONTROL SYSTEM | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Backup hydraulic pump | X | | | |
| Servo off 1st stage/PLT | X | | | |
| Servo off 2nd stage/PLT | X | | | |
| Servo off 1st stage/COPLT | X | | | |
| Servo off 2nd stage/COPLT | X | | | |
| Hydraulic leak test | X | | | |
| Tail servo | X | | | |
| Boost servos | X | | | |

| FUEL SYSTEM | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Fuel pump switch | X | | | |
| Fuel boost pump #1 | X | | | |
| Fuel boost pump #2 | X | | | |
| Fuel cont panel ESSS | Not installed | | | |

| WARNING SYSTEM | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Low rotor RPM | X | | | |
| Master caution | X | | | |
| Caution advisory | X | | | |
| Fire warning | X | | | |
| AFCS | X | | | |
| Stabilator | X | | | |
| #1 engine out | X | | | |
| #2 engine out | X | | | |

| NAVIGATION INSTRUMENTS | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| ADF | X | | | |
| Magnetic compass | X | | | |
| CONUS NAV, ARN-123 | X | | | |
| DOPPLER, ASN-128 | X | | | |
| Gyro mag compass (PLT) | X | | | |
| Gyro mag compass (COPLT) | X | | | |
| Compass cont panel, ASN-75 | X | | | |
| HSI | X | | | |

| FLIGHT INSTRUMENTS | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Radar altimeter | X | | | |
| Stabilator pos indicator | X | | | |
| VSI | X | | | |
| CIS mode select | X | | | |
| SAS 1 | X | | | |
| SAS 2 | X | | | |
| FPS | X | | | |
| Trim | X | | | |
| Go-around enable | X | | | |
| Cyclic trim release | X | | | |
| Cyclic stick trim | X | | | |
| ALR encoder | X | | | |

| FLIGHT INSTRUMENTS (CONT) | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| HSI/VSI mode select (PLT) | | | | |
| DPLR | X | | | |
| VOR/ILS | X | | | |
| BACK CRS | X | | | |
| FM HOME | X | | | |
| TURN RATE | X | | | |
| CRS HDG | X | | | |
| VERT GYRO | X | | | |
| BRG 2 | X | | | |
| HSI/VSI Mode Select (COPLT) | | | | |
| DPLR | X | | | |
| VOR/ILS | X | | | |
| BACK CRS | X | | | |
| FM HOME | X | | | |
| TURN RATE | X | | | |
| CRS HDG | X | | | |
| VERT GYRO | X | | | |
| BRG 2 | X | | | |

| MISCELLANEOUS EQUIPMENT | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Blade deice | Not tested | | | Ambient temperature was out of test limits. |
| Windshield anti-ice | X | | | |
| Pitot heat | X | | | |
| Vent blower | X | | | |
| Windshield wiper | X | | | |
| Heater | X | | | |
| APU | X | | | |
| Generator #1 | X | | | |
| Generator #2 | X | | | |
| Generator APU | X | | | |
| Air source heat start | X | | | |
| Tail wheel lock | X | | | |
| Gyro erect | X | | | |

| LIGHTING | No EMI Affect | EMI Affected Gnd | EMI Affected Flt | Explanation |
|---|---|---|---|---|
| Cockpit utility | X | | | |
| Cockpit flood | X | | | |
| Cabin dome | X | | | |
| Search light | X | | | |
| Search light control | X | | | |
| Landing light | X | | | |
| Flt instr lights (PLT) | X | | | |
| Flt instr lights (COPLT) | X | | | |
| Nonflight instr lights | X | | | |
| Console lights, upper | X | | | |
| Console lights, lower | X | | | |
| Position lights | X | | | |
| Formation lights | X | | | |
| Anticollision lights | X | | | |
| NVG lighting | X | | | |

### 3.2.5 Battery life evaluation

**Battery Life Evaluation Report Form**

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Manufacturer battery life specification: 12 to 26 hours on 30-second cycle with a new battery.

Specified battery recharge time: NA

Specified mode of operation under battery power: 30-second cycle mode, in which automatic temperature measurements are taken at 30-second intervals and recorder on.

Overall performance: Pass

Measurements: The unit averaged 14.83 hours of operation.

Comments: The unit was operated continuously in the 30-second cycle mode until a low battery indication occurred. The depletion time was noted and the battery was replaced. This procedure was repeated three times.

### 3.2.6 Human factors evaluation

Human Factors Evaluation
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 5 Jul 90

Item configuration during test: Item prepared for operation, sitting on a counter top, sensor pill in styrofoam cup of water.

Checklist for HFE

RESULTS

VISUAL DISPLAYS: Unsatisfactory

display type, format, content
location of displays
indicator lights
scalar displays
color coding
legends and labels
cathode ray tubes
counters
flags, go-no-go, center-null indicators

Comments: Button on the top of the unit is unmarked. Front panel button labels do not always indicate their function.

CONTROLS: Unsatisfactory

location
characteristics of controls
labeling
control - display relationships

Comments: No tactile feedback for locating front panel buttons or to verify that contact was made. Power switch is part of battery compartment cover. Cover may be misplaced, rendering the unit useless. It is not possible to turn the unit on or off while it is in the protective cover.

TIME REQUIRED TO PREPARE FOR OPERATION (list in comment)

Comments: 3 to 4 minutes.

MAINTAINABILITY: Unsatisfactory

component location
component characteristics
rests and stands
covers, cases, access doors
handles
lubrication
component mounting
cord storage provisions
external accessibility
internal accessibility
list special tools required
list realistic inspection requirements
list realistic inspection intervals

Comments: Unit must be placed in cover before it is set up for use. Not possible to turn power on or off while it is in the cover. Not possible to connect the printer while it is in the cover. Cover is tight and requires some effort to install.

CONDUCTORS: Satisfactory

binding and securing
length
protection
routing
conductor coding
fabrication
connectors

Comments: None

FASTENERS: Satisfactory

access through inspection panel covers
enclosure fasteners
device mounting bolts and fasteners

Comments: Difficult to connect and disconnect battery.

TEST POINTS: NA

general
location and mounting
test point labeling and coding

Comments: None

TEST EQUIPMENT: Satisfactory

general
equipment self-test
indicators (list in comments)
controls
positive indication of proper operation

Comments: A self test is initiated with each use. Low battery is indicated. Unit includes tests for pill on/off and weak signal.

FUSES AND CIRCUIT BREAKERS: NA

external accessibility
easy replacement or reset by operator

Comments: No fuses are externally accessible.

LABELS AND CODING: Unsatisfactory

placed above controls and displays
near or on the items they identify
not obscured by other equipment components
describe the function of the items they identify
readable from normal operating distance
conspicuous placards adjacent to hazardous items

Comments: Button labels do not always describe their function.

SAFETY: Unsatisfactory

manual
materials
fire and explosive protection
operator protection from mechanical hazards
patient protection from mechanical hazards
electrical safety (operator and patient)

Comments: Manual is difficult to understand, some instructions are incorrect, and some examples are wrong. Some components described in the manual do not exist. Errors in the operator's manual may lead to improper operation of the device. The manual lacks specifications for the device.

3.2.7 Altitude test

Altitude Test
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 17 Jul 90

Item configuration during test: Sitting on custom styrofoam stand in the chamber. Pill submerged in styrofoam cup of warm water.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 74°F |
| Humidity | 80% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None (battery) |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | Serial port |

IN-TEST DATA

Time of test start: 1340

POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Time of test end: 1440

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

### 3.2.8 Vibration test

Vibration Test
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 17 Jul 90

Item configuration during test: Item strapped down on vibration table fixture; pill submerged in warm water.

Performance test criteria: Consistent and accurate measurements and displays.

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None (battery) |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | Serial port |

Ambient conditions

| | |
|---|---|
| Temperature | 74°F |
| Humidity | 80% RH |
| Barometric pressure | 1 atm |

IN-TEST DATA

Data and performance checks during test:

Times and dates of test start: 0945

Time at first check:
X: 0945 Y: 1200 Z: 0810

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

Time at second check:
X: 0950 Y: 1250 Z: 0810

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Item functional (based on performance test criteria): Yes

Item intact: Yes

Deviation from pretest: None

Comments on item setup or checks:
Times are on different days

Comments on test run (including interruptions): The z-axis test was completed in two test runs due to a test abort after 46 minutes on the first run. The test interruption was not caused by the test device.

Comments on other data: None

3.2.9 High temperature test

High Temperature Test
(Equipment Operating)
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 5 Jul 90

Item configuration during test: Unit was sitting on wire test stand with antenna elevated on a box 0.38 meters above the chamber floor. Pill submerged in warm water and placed in the antenna loop.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 24°C |
| Humidity | 52% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | Serial port |
| distance from north wall (meters) | 0.762 |
| distance from south wall (meters) | 0.813 |
| distance from east wall (meters) | 1.397 |
| distance from west wall (meters) | 1.626 |
| distance from ceiling (meters) | 1.575 |
| distance from floor (meters) | 0.533 |

IN-TEST DATA

Time of test start: 0950

Performance checks during test:

First check:

| | |
|---|---|
| Time: | 1035 |
| Temperature: | 49°C |
| Humidity: | 15% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes, all OK |
| Deviation from pretest: | None |

Second check:

| | |
|---|---|
| Time: | 1105 |
| Temperature: | 49°C |
| Humidity: | 15% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes, all OK |
| Deviation from pretest: | None |

Third check:

| | |
|---|---|
| Time: | 1135 |
| Temperature: | 49°C |
| Humidity: | 15% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes, all OK |
| Deviation from pretest: | None |

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

| | |
|---|---|
| Time of test end: | 1215 |
| Item functional (based on performance test criteria): | Yes, all OK |
| Deviation from pretest: | None |

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

## 3.2.10 High temperature storage test

High Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 10 Jul 90

Item configuration during test: Sitting on wire test stand, in storage, not operating.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 25°C |
| Humidity | 56% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | All |
| distance from north wall (meters) | 0.762 |
| distance from south wall (meters) | 0.813 |
| distance from east wall (meters) | 1.397 |
| distance from west wall (meters) | 1.626 |
| distance from ceiling (meters) | 1.575 |
| distance from floor (meters) | 0.533 |

Time of test start: 0805

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1405
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.11 Low temperature test

Low Temperature Test
(Equipment Operating)
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 6 Jul 90

Item configuration during test: Sitting on wire test stand, antenna sitting on box 0.38 meters above the chamber floor. Pill submerged in warm water and placed in the antenna loop.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 25° C |
| Humidity | 52% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes
All OK Pass

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | Serial port |
| distance from north wall (meters) | 0.762 |
| distance from south wall (meters) | 0.813 |
| distance from east wall (meters) | 1.397 |
| distance from west wall (meters) | 1.626 |
| distance from ceiling (meters) | 1.575 |
| distance from floor (meters) | 0.533 |

Time of test start: 0805

Performance checks during test:

First check:

| | |
|---|---|
| Time: | 0835 |
| Temperature: | 0°C |
| Humidity: | NA |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Second check:

| | |
|---|---|
| Time: | 0905 |
| Temperature: | 0°C |
| Humidity: | NA |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Third check:

| | |
|---|---|
| Time: | 0935 |
| Temperature: | 0°C |
| Humidity: | NA |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

| | |
|---|---|
| Time of test end: | 1015 |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.12 Low temperature storage test

Low Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 9 Jul 90

Item configuration during test: Antenna cable is coiled and placed next to the unit. Unit on wire test stand in storage, not operating.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 27°C |
| Humidity | 53% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | All |
| distance from north wall (meters) | 0.762 |
| distance from south wall (meters) | 0.813 |
| distance from east wall (meters) | 1.397 |
| distance from west wall (meters) | 1.626 |
| distance from ceiling (meters) | 1.575 |
| distance from floor (meters) | 0.533 |

Time of test start: 0850

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1450
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: The unit was allowed to return to ambient conditions overnight before final performance check.

### 3.2.13 Humidity test

Humidity Test
Report Form

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: None

Options installed: None

Date of test: 11 Jul 90

Item configuration during test: The unit was sitting on wire test stand, ready for operation.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

| | |
|---|---|
| Temperature | 26°C |
| Humidity | 51% RH |
| Barometric pressure | 1 atm |

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

| | |
|---|---|
| list connections to power | None |
| list connections to simulators | None |
| list connections to dummy loads | None |
| list unconnected terminals | Printer port |
| distance from north wall (meters) | 0.762 |
| distance from south wall (meters) | 0.813 |
| distance from east wall (meters) | 1.397 |
| distance from west wall (meters) | 1.626 |
| distance from ceiling (meters) | 1.575 |
| distance from floor (meters) | 0.533 |

IN-TEST DATA

Time of test start: 0820

Performance checks during test:

First check:

| | |
|---|---|
| Time: | 0905 |
| Temperature: | 29.5°C |
| Humidity: | 95% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Second check:

| | |
|---|---|
| Time: | 0950 |
| Temperature: | 29.5°C |
| Humidity: | 95% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Third check:

| | |
|---|---|
| Time: | 1035 |
| Temperature: | 29.5°C |
| Humidity: | 95% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Fourth check:

| | |
|---|---|
| Time: | 1120 |
| Temperature: | 29.5°C |
| Humidity: | 95% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

Fifth check:

| | |
|---|---|
| Time: | 1205 |
| Temperature: | 29.5°C |
| Humidity: | 95% RH |
| Barometric pressure: | 1 atm |
| Item functional (based on performance test criteria): | Yes |
| Deviation from pretest: | None |

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 1220
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

## 3.2.14 Electromagnetic characteristics test

**********

Electromagnetic Characteristics Testing
Evaluation of Performance
**********

T & E Item Number: 06 Date: 29 Jun 90

Nomenclature: Core temperature recorder
Manufacturer: Human Technology
Model number: COR-124
Serial number: CA001071CB
Military item number: NA

**********

Conducted emissions tests

CE01 Testing configuration(s): NA
Performance (pass/fail): NA

Comments: NA

CE02 Testing configuration(s): NA
Performance (pass/fail): NA

Comments: NA

CE04 Testing configuration(s): NA
Performance (pass/fail): NA

Comments: NA

Conducted susceptibility tests

CS02 Testing configuration(s): NA
Performance (pass/fail): NA

Comments: NA

CS06 Testing configuration(s): NA
Performance (pass/fail): NA

Comments: NA

Radiated emissions tests

RE02 Testing configuration(s): Operating on wooden test stand in the EMC chamber, battery power.
Performance (pass/fail): Fail

Comments:

| Frequency range | Emission exceeding standard |
|---|---|
| 3.9590 - 24.159 MHz | 0.4 - 18.3 dB (NB) |
| 33.994 - 73.989 MHz | 8.0 - 36.7 dB (NB) |
| 100.80 - 171.83 MHz | 1.1 - 18.1 dB (NB) |
| 0.2 MHz | 1.9 dB (BB) |

Radiated susceptibility tests

RS03 Testing configuration(s): Operating on the wooden test stand in the EMC chamber, battery power.
Performance (pass/fail): Fail
Comments: Frequency ranges and field strengths when susceptibility detected.

With the software filter "on":

| Frequency range | Field strength |
|---|---|
| 40.2 MHz | 5.62 V/m |
| 128.6 - 149.0 MHz | 5.31 - 8.91 V/m |
| 264.0 MHz | 8.91 V/m |

With the software filter "off":

| Frequency range | Field strength |
|---|---|
| 30.0 MHz | 5.01 V/m |
| 40.2 MHz | 6.31 V/m |
| 70.8 MHz | 5.96 V/m |
| 145.6 - 159.2 MHz | 6.68 - 7.08 V/m |

## 3.3 CRITERIA, SIGNIFICANT PROBLEMS, AND SUGGESTED IMPROVEMENTS

### 3.3.1 Criteria

| Item No. | Criteria (source) | Remarks | Applicable subparagraph |
|---|---|---|---|
| 1 | The physical inventory is conducted solely for investigation and documentation. | NA | 2.1.2.1 |
| 2 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements. | met | 2.1.2.2 |
| 3 | Verify manufacturer's specified full power battery life expectancy of 12 to 26 hours during continuous operation in the 30-second cycle. | met | 2.2.2 |
| 4 | The Ambulatory Cortemp Recorder will be rated satisfactory in all major categories of the evaluation. These include: Visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety. | partially met | 2.3.2 |
| 5 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements while exposed to an altitude equivalency of 15,000 feet above sea level. | met | 2.4.2 |
| 6 | The Ambulatory Cortemp Recorder will remain operational and display consistent and accurate measurements while exposed to vibrational stresses. | met | 2.5.2 |
| 7 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements during the high temperature operation check. | met | 2.6.2.1 |

| | | | |
|---|---|---|---|
| 8 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements after the high temperature storage. | met | 2.6.2.2 |
| 9 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements during the low temperature operation check. | met | 2.7.2.1 |
| 10 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements after the low temperature storage. | met | 2.7.2.2 |
| 11 | The Ambulatory Cortemp Recorder will display consistent and accurate measurements while exposed to a high humidity. | met | 2.8.2 |
| 12 | The Ambulatory Cortemp Recorder will not produce emissions in excess of the limits set forth in MIL-STD-461A Notice 4, paragraph 6.13. | partially met | 2.9.2.1 |
| 13 | The Ambulatory Cortemp Recorder will not malfunction when it is subjected to radiated fields as specified in MIL-STD-461A, Notice 4, paragraph 6.20. | partially met | 2.9.2.2 |
| 14 | The flight surgeon will be able to operate the Ambulatory Cortemp Recorder without physical or functional restrictions aboard the aircraft. | partially met | 2.10.2.1 |
| 15 | The Ambulatory Cortemp Recorder will not radiate EMI to disrupt or interfere with the other equipment or systems aboard the aircraft. | met | 2.11.2.2 |
| 16 | The aircraft will not radiate EMI to disrupt or interfere with the Ambulatory Cortemp Recorder. | met | 2.11.2.3 |

### 3.3.2 Significant problems which require corrective action

None

### 3.3.3 Suggested improvements

None

## 3.4 REFERENCES

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3.4.5 Underwriters Laboratory's, Inc. 1978. Standard for safety, medical and dental equipment. Chicago, Illinois. UL-544.

3.4.6 Department of Defense. 1989. Human engineering design criteria for military systems, equipment, and facilities. Washington, DC. MIL-STD-1472D. March.

3.4.7 Association for the Advancement of Medical Instruments. Human factors engineering guidelines and preferred practices for the design of medical devices. Arlington, Virginia. AAMI-HE-1988. February.

## 3.5 ABBREVIATIONS

| | |
|---|---|
| AVSCOM | U.S. Army Aviation Systems Command |
| AWR | airworthiness release |
| BB | broadband |
| CAAF | Cairns Army Airfield |
| dB | decibel |
| DTS | disposable temperature sensor |
| EMC | electromagnetic compatibility |
| EMI | electromagnetic interference |
| fpm | feet per minute |
| GFE | government furnished equipment |
| Gpk | gravity, peak |
| G(rms) | gravity (root mean square) |
| Hz | hertz |
| IAW | in accordance with |
| kHz | kilohertz |
| LCD | liquid crystal display |
| MEDEVAC | medical evacuation |
| MHz | megahertz |
| MIL-STD | military standard |
| mL | milliliter |
| mm | millimeter |
| mmHg | millimeters of Mercury |
| MSL | mean sea level |
| NB | narrowband |
| NBC | nuclear, biological and chemical |
| NVG | night vision goggle |
| NOE | nap-of-the-earth |
| RF | radio frequency |
| RFI | radio frequency interference |
| RH | relative humidity |

| | |
|---|---|
| T & E | test and evaluation |
| UES | Universal Energy Systems, Inc. |
| USAARL | U.S. Army Aeromedical Research Laboratory |
| V/m | volts per meter |

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